

on cartesians, and his vector work is apt to degenerate into cartesian shorthand. The object of a calculus is not to save printing, and it is no advantage to have an expression condensed into two or three symbols if you have to think it out at length to understand it. Shorthand is not necessarily short-thought, especially if it also involves writing operators as quantities. It is possible to know the meaning of

$$\left(\mu\rho - \frac{\nabla^2}{c\rho}\right)H \text{ where } \frac{1}{\rho} \text{ is } \frac{dt}{d},$$

it is also possible to know what is meant by "Boyle was the father of chemistry, and brother to the Earl of Cork." It might be suggested that if Mr. Heaviside wants to make either vector analysis or quaternions simple to physicists, he should avoid the confusion between operators and quantities, and between operation generally and multiplication in particular; or else write an introductory calculus of functions showing where such liberties can be taken with impunity.

Mr. Heaviside has a rooted aversion to 4π . This factor came into the system of units from statics, as the mathematical treatment of electricity was much the same. Mr. Heaviside employs a medium treatment, and thinks that 4π should, therefore, disappear. He thinks that Maxwell and other mathematicians did not know how 4π came about, and thought it was a physical necessity. With his treatment it is an advantage to remove the 4π from its usual place; but it only appears in the denominator elsewhere. It is like the eruption due to a disease: suppress it, and it appears elsewhere. The unsavoury metaphor is not ours. The disease is the area of a unit sphere being 4π . Until Mr. Heaviside can cure that, he cannot really eliminate 4π . He whitewashes 4π whenever it appears in his book, saying that it is not the B.A. 4π of amazing irrationality. When a man refers to his own ideas as alone rational, or based on common-sense, or well-known facts, he is generally wrong.

Mr. Heaviside is, as is well known, a prolific inventor of new terms. He says he hates grammar; he has also a murderous hatred of the Queen's English when inventing terms such as "leakance," "reactance," and "potted." Generally speaking, a writer has no business to insist that his reader shall study a new terminology; but when any one of Mr. Heaviside's reputation invents names which are euphonious and good, they become parts of our language, and we must thank him, especially when his terms are suggestive and systematic. The example is bad though. The English language is capable of improvement; but if every writer is to alter it to suit his ideas, it will not improve. It is a matter of taste which terms should be adopted; many object to voltage and gausage as unsystematic where ampereage, farradage, &c., are not used. Voltage was originally used to denote the pressure for which lamps, dynamos, &c., were designed by the maker, whatever they were run at. Pressure belongs to the same set of ideas as current, capacity, resistance, and quantity; and if they are used, should also be employed. It is, however, a matter of taste only.

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The style is that of Whitman, except that Mr. Heaviside is not affected, and has something to say. The similarity is also noted in the *Philosophical Magazine*. Every line of the book is important, and it is full of interesting digressions on all sorts of subjects. Though the converse may not be true, all clever men have a sense of humour, and it is therefore a pity that scientific writers emulate the ponderous dryness of the theologian. Mr. Heaviside's work bristles with humour of a type which he has invented.

It is generally assumed that a review should be written by a man who could have written the book himself. In the case of a writer of Mr. Heaviside's calibre there is difficulty in getting such reviewers. The real object of a book is, however, to teach not those who know the contents already, but the student, and it may therefore be an advantage to review a book from the student's point of view. This review must, therefore, be taken as from that point of view; that is, as written by a reader who has not devoted a large enough portion of his time to the study of mathematics or mathematical physics to be more than a student of them.

J. SWINBURNE.

RECENT PSYCHOLOGY.

Lectures on Human and Animal Psychology. By Wilhelm Wundt. Translated by J. E. Creighton and E. B. Titchener. Pp. x. 454. (London: Swan Sonnenschein and Co., 1894.)

Grundriss der Psychologie. Von Oswald Külpe. Pp. viii. 478. (Leipzig: W. Engelmann, 1893.)

Introduction to Comparative Psychology. By C. Lloyd Morgan. Pp. xiv. 382. (London: Walter Scott, 1894.)

Psychology for Teachers. By C. Lloyd Morgan. Pp. x. 251. (London: Edward Arnold, 1894.)

Primer of Psychology. By George Trumbull Ladd. Pp. xv. 224. (London: Longmans, Green, and Co., 1894.)

THE translation of Prof. Wundt's well-known lectures is taken from the second revised German edition which appeared in 1892, and is therefore well up to date. It is the first work of the author to appear in English, and the choice made by the translators is a good one; while the book will give to those specially interested in psychology a general sketch of the author's views. Its popular and lucid form will appeal to a wider circle of readers who would hardly care to digest the details and technicalities of the "Grundzüge der physiologischen Psychologie."

The greater part of the book is devoted to human Psychology, especially in its physiological and experimental aspects, and there are several interesting chapters on animal psychology, and a short account of the author's views on hypnotic conditions. Prof. Wundt's own opinions are stated rather more dogmatically than is altogether suitable for an elementary book in a science like psychology; thus, in dealing with intensity of sensation, the validity of the logarithmic formula is very positively enunciated, and it is somewhat surprising to find

on p. 306, that indirect association of ideas is "easily demonstrated," when several investigators, one recently in Prof. Wundt's own laboratory, have failed to find any evidence of such a mode of association.

The translation has been very well done, and especial care has evidently been devoted to the rendering of the German psychological terms. The translators have very freely used the term "to sense" as a verb corresponding to sensation, and as the equivalent of "empfinden." This American innovation, which has already been advocated by Dr. Titchener, is also used by Prof. Lloyd Morgan in his two books, and it must be acknowledged that there is decided need of some such term.

Dr. Külpe is chief assistant to Prof. Wundt at the Leipzig Institute, and his experience in teaching and in directing investigation must have contributed largely to make his book what it is—one of the best existing expositions of experimental psychology. The general teaching follows that of Wundt, but there is much that is novel in matter and arrangement. Physiological details and the technique of experimental methods are omitted or treated very briefly, but the principles of the methods are fully discussed. Dr. Külpe's book will probably be largely used as a text-book for advanced students.

Prof. Lloyd Morgan's two books, to a certain extent, cover the same ground. Each is an exposition of general psychological principles to serve as guides, in the one case, to the scientific study of the animal mind; in the other, to the practical study of the child's mind. Both books are characterised by the sound common sense with which the author treats his problems.

The views held on the nature of the animal mind are very similar to those of Wundt. Both agree that in studying animal psychology the scientific method is to explain actions by the simplest possible mental processes, and this method has led both to similar conclusions, although expressed in somewhat different language. Wundt refers all intelligent acts of animals to simple associations, to the exclusion of any higher apperceptive process; while Prof. Morgan explains such acts by simple sense experience, and doubts, though he does not deny, the existence of any true reasoning or reflective process. A point justly insisted on by Prof. Morgan is that observation of an apparently rational action in an animal is of little value without knowledge of the process by which the action has been developed; "in zoological psychology we have got beyond the anecdotal stage; we have reached the stage of experimental investigation."

The book for teachers is very interesting, and contains much that should be of practical value. It is noteworthy that the appreciative preface, with its ample recognition of the part that a knowledge of psychology should take in the equipment of the teacher, is written by Dr. Fitch, late one of H.M. Chief Inspectors of Training Colleges.

Prof. Ladd has attempted a very difficult task in writing a primer of psychology suited for the young. His book is often simple and clear; it is to be feared, however, that youthful readers will find much of it beyond their capacity. The author has, at any rate, avoided the fault of being too dogmatic.

OUR BOOK SHELF.

Radiant Suns. By Agnes Giberne. (London: Seeley and Co., 1895.)

IN this sequel to a former work, the reader is taken by easy stages into the domain of spectroscopic astronomy and the evolution of worlds. Though following some astronomers who ought to know better, the authoress takes the unphilosophical view that the whole process of stellar evolution is one of cooling; and this is the more difficult to understand, as she is evidently not unfamiliar with the fact that a condensing body may actually be getting hotter (p. 307). While strongly advocating the value of hypotheses as aids to investigation, she is inconsistent enough to make contemptuous reference to the "half-fledged" theories of "scientists of a lower order" (p. 240); her qualifications for making such distinctions are not very clear to us, but her opinions seem to depend to some extent on personal bias, since special prominence is given to the views and work of one observer.

A preface is contributed by Mrs. Huggins, who is careful to disclaim responsibility in matters of opinion, and laments that the masses of men overlook the fact that "the investigator, absorbed in pursuits far removed from those of ordinary life, is also a toiling worker, and a worker of the highest order."

The illustrations are admirable and quite up to date. It would be worth while, however, to revise the coloured plate of stellar spectra, so that the spectrum of Vega would not be robbed of its strongest characteristic—the lines of hydrogen.

We believe that the book will succeed in awakening a desire for further knowledge in the minds of thoughtful readers; and if so, it will serve a useful purpose.

Album von Papua-Typen. Von A. B. Meyer and R. Parkinson. (Dresden: Stengel und Markert, 1894.)

TO ethnologists, the Papuan race is one of the most interesting in the world. Whether the Papuan represents a distinct type of mankind or not is doubted by some observers, though the balance of evidence is in favour of that conclusion. This splendid collection of fifty-four plates reproduced from photographs, and representing about six hundred portraits of individuals, should be of great assistance in studying the similarities and differences between the typical Papuan, and the natives of southern and eastern New Guinea. The photographs illustrate the natives of New Britain, the Duke of York Islands, New Ireland, Admiralty Islands, Solomon Islands, German New Guinea, and Dutch New Guinea. They represent the people as they are ordinarily seen, and also decorated with the strange costumes assumed at feasts. Particularly striking are the pictures of natives of New Britain adorned for one of their Dukduk dances, and of the ingenious basket-work traps used by the fishermen. Ethnology will benefit by the publication of this collection of really excellent pictures.

Farm Vermin, Helpful and Harmful. By various Writers. Edited by John Watson, F.L.S. Pp. 85. (London: William Rider and Son, Limited, 1894.)

COMPOSITE books are almost always unsatisfactory, the chapters by the various contributors being necessarily unequal in quality and length. We really cannot understand why this little book of eighty pages should not have been written by a single zoologist, instead of the eight who have helped to construct it. The only justification for the patch-work is that each of the writers is more or less an authority upon the subject he describes; but the book is of such an elementary